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For: INDOOR UNIT OF AIR CONDITIONER :  
AND METHOD FOR MANUFACTURING: :  
THEREOF (AS AMENDED) :

SUBMISSION OF TRANSLATION

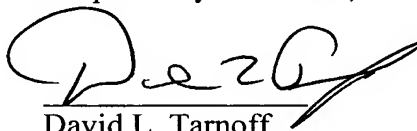
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Sir:

Applicants submit herewith an English translation of International Patent Application No. PCT/JP2004/011826 including 13 pages and 15 sheets of drawing.

The attached document represents a true and complete English translation of International Patent Application No. PCT/JP2004/011826.

Respectfully submitted,

  
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# SPECIFICATION

## INDOOR UNIT OF AIR CONDITIONER AND METHOD OF MANUFACTURING THE INDOOR UNIT

### TECHNICAL FIELD

5           The present invention relates to an indoor unit of an air conditioner and a method for manufacturing thereof.

### BACKGROUND ART

10           Recently, the design of the front panel of an indoor unit of an air conditioner has been improved by painting thereon and the like. However, if painting is simply applied on the front surface of the front panel of an indoor unit, there is a risk that its design may be hampered by a scratch on painting during installation of the indoor unit. Consequently, a technique that painting is applied on the reverse side of a transparent front panel has been suggested (for example, refer to Japanese Patent Application 2002-355175).

15           Incidentally, a front panel is typically integrally molded with a mounting portion (such as a clip and/or a hinge) attached to the main body. However, when a transparent front panel is molded in this manner and the panel is given a color scheme or pattern on the reverse side surface and the mounting portion thereof, it often creates a difference in visual effects between a portion of the front side corresponding to the mounting portion and the remaining flat portion of the front side. In addition, when this difference in visual effects is excessively large, the design of the front panel as a whole may be hampered.

### DISCLOSURE OF INVENTION

          An object of the present invention is to obviate a risk that the design of the front panel and the like of an indoor unit may be hampered by a mounting portion and the like attached to the main body.

25           An indoor unit of the air conditioner according to a first aspect of the present invention comprises a main body, a front panel, and a design panel. The front panel is opaque and is integrally molded with a mounting portion. Note that this mounting portion is provided for mounting the front panel to the front portion of the main body, and comprises, for example, a hinge (which enables the front panel to open and close) and/or a clip. The design panel is transparent and is attached to the front panel. Additionally, this design panel is provided with a design layer on the reverse side thereof. Note that this design layer is at least given a color scheme. Additionally, this design layer may further be given a pattern.

35           Here, the design panel is attached to the front panel. Additionally, the front panel is opaque as in conventional panels. Consequently, the mounting portion cannot be seen from the front of indoor unit. Thus, it is possible to obviate a risk that the design of the front panel of the indoor unit and the like may be hampered by the mounting portion and the like

attached to the main body.

An indoor unit of the air conditioner according to a second aspect of the present invention is the indoor unit of the air conditioner according the first aspect of the present invention, wherein the design panel is attached to the front panel at a peripheral portion of the design panel. Note that, in this case, the design panel is attached to the main body by a method as fitting with a clip, screwing, fusion, bonding, adhesion, and the like.

Here, the design panel is attached to the front panel at a peripheral portion of the design panel. Therefore, it is possible to maintain the design of at least the main portion of the design panel.

An indoor unit of the air conditioner according to a third aspect of the present invention comprises a main body, a front panel, and a mounting portion. The front panel is transparent and is disposed at the front portion of the main body. Additionally, this front panel is provided with a design layer on the reverse side thereof. Note that this design layer is at least given a color scheme. Additionally, this design layer may further be given a pattern. The mounting portion is provided for mounting the front panel to the front portion of the main body, and comprises, for example, a hinge (which enables the front panel to open and close) and/or a clip. A part of this mounting portion is attached onto the design layer. Note that, in this case, the mounting portion is attached onto the design layer by a method as bonding,, adhesion, or the like.

Here, the design layer is provided on the reverse side of the front panel. And, a part of this mounting portion is attached onto the design layer. Consequently, the mounting portion cannot be seen from the front of the indoor unit. Thus, it is possible to obviate a risk that the design of the front panel of the indoor unit and the like may be hampered by the mounting portion and the like attached to the main body.

A method for manufacturing an indoor unit of an air conditioner according to a fourth aspect of the present invention is the method to manufacture the indoor unit of the air conditioner according to the first aspect of the present invention, and the method comprises a first step and a second step. In the first step, a design layer is formed on a portion or the entirety of the reverse side of the transparent design panel. In the second step, the design panel is attached to the main body such that the reverse side of the design panel and a part of the front portion of the main body face each other.

Here, when the indoor unit of the air conditioner is manufactured according to this method for manufacturing, the design layer is formed on a portion or the entirety of the reverse side of the transparent design panel in the first step. Then, in the second step, the design panel is attached to the main body such that the reverse side of the design panel and a part of the front portion of the main body face each other. Consequently, the mounting

portion cannot be seen from the front of the indoor unit. Thus, it is possible to obviate a risk that the design of the front panel of the indoor unit and the like may be hampered by a mounting portion and the like attached to the main body.

A method for manufacturing an indoor unit of an air conditioner according to a fifth aspect of the present invention is the method to manufacture the indoor unit of the air conditioner according to the third aspect of the present invention, and the method comprises a first step and a second step. In the first step, a design layer is formed on a portion or the entirety of the reverse side of the transparent front panel. In the second step, a part of the mounting portion is attached onto the design layer.

Here, when the indoor unit of the air conditioner is manufactured according to this method for manufacturing, the design layer is formed on a portion or the entirety of the reverse side of the transparent front panel in the first step. Then, in the second step, a part of the mounting portion is attached to the design layer. Consequently, the mounting portion cannot be seen from the front of the indoor unit. Thus, it is possible to obviate a risk that the design of the front panel of the indoor unit and the like may be hampered by the mounting portion and the like attached to the main body.

#### **BRIEF DESCRIPTION OF DRAWINGS**

Figure 1 is a general view of an air conditioner.

Figure 2 is a system diagram of a refrigerant circuit of the air conditioner.

Figure 3 is a side cross section of an indoor unit according to a first embodiment.

Figure 4 is a perspective view showing constituent parts of an indoor unit casing according to the first embodiment.

Figure 5 is a flowchart showing a method for manufacturing the indoor unit of the air conditioner according to the first embodiment.

Figure 6 is a flowchart showing steps for manufacturing the indoor unit casing according to the first embodiment.

Figure 7 is a perspective view showing a method for manufacturing a front panel of the indoor unit according to the first embodiment.

Figure 8 is a perspective view showing a method for manufacturing of the front panel of the indoor unit according to a modified example of the first embodiment.

Figure 9 is a perspective view of a front panel and a decoration panel of an indoor unit according to the second embodiment.

Figure 10 is a flowchart showing steps for manufacturing an indoor unit casing according to the second embodiment.

Figure 11 is a perspective view showing the structure of a mounting portion between a design panel and a front panel according to the second embodiment.

Figure 12 is a perspective view showing the structure of a mounting portion between the design panel and the front panel according to the second embodiment.

Figure 13 is a perspective view showing a method for attaching a design panel according to a modified example (1) of the second embodiment.

5 Figure 14 is a perspective view showing a method for attaching the design panel according to a modified example (2) of the second embodiment.

Figure 15 is a perspective view showing a method for attaching the design panel according to a modified example (3) of the second embodiment.

10 Figure 16 is a side cross section of the decoration panel according to the second embodiment.

#### **DESCRIPTION OF THE REFERENCE SYMBOLS**

25a	Front grill (main body)
26a, 26b	Front panel (front panel)
27a, 27b	Painting layer (design layer)
15 71, 74	Hinge (mounting portion)
72	Mounting member (hinge+lower clip) (mounting portion)
73	Lower clip (mounting portion)
80, 81, 83, 84	Decoration panel (design panel)
261, 262	Coated portion (reverse side surface)

#### **BEST MODE FOR CARRYING OUT THE INVENTION**

<First Embodiment>

<Entire Structure of the Air Conditioner>

Figure 1 shows an external appearance of an air conditioner 1 according to a first embodiment.

25 This air conditioner 1 comprises a wall-hanging indoor unit 2 attached to a wall surface in the room, and an outdoor unit 3 installed outdoors.

Inside the indoor unit 2 is housed an indoor heat exchanger and inside the outdoor unit 3 is housed an outdoor heat exchanger. These heat exchangers are connected to each other via a refrigerant pipe 4, thus constituting a refrigerant circuit.

30 <Schematic Constitution of the Refrigerant Circuit of the Air Conditioner>

Figure 2 shows the constitution of the refrigerant circuit of the air conditioner 1. This refrigerant circuit mainly comprises an indoor heat exchanger 20, an accumulator 31, a compressor 32, a four-way switching valve 33, an outdoor heat exchanger 30, and a motor-operated expansion valve 34.

35 The indoor heat exchanger 20 provided inside the indoor unit 2 exchanges heat with the air with which it comes in contact. In addition, the indoor unit 2 is provided with a cross

flow fan 21 that takes in the indoor air, passes the air through the indoor heat exchanger 20 for heat exchange, and then discharges the air into the room. The cross flow fan 21 is formed in a cylindrical shape, is provided with blades on its circumferential surface in the direction of the rotational axis, and generates air flow in the direction perpendicular to the rotational axis. This cross flow fan 21 is rotatably driven by an indoor fan motor 22 provided inside the indoor unit 2. The constitution of the indoor unit 2 is described in detail later.

The outdoor unit 3 comprises the compressor 32, the four-way switching valve 33 connected to a discharge side of the compressor 32, the accumulator 31 connected to an inlet side of the compressor 32, the outdoor heat exchanger 30 connected to the four-way switching valve 33, and the motor-operated expansion valve 34 connected to the outdoor heat exchanger 30. The motor-operated expansion valve 34 is connected to a pipe 41 via a filter 35 and a liquid shutoff valve 36, and is connected to one end of the indoor heat exchanger 20 via this pipe 41. In addition, the four-way switching valve 33 is connected to a pipe 42 via a gas shutoff valve 37, and is connected to the other end of the indoor heat exchanger 20 via this pipe 42. These pipes 41, 42 are identified as the refrigerant pipe 4 shown in Figure 1. In addition, the outdoor unit 3 comprises a propeller fan 38 for externally discharging air after its heat has been exchanged by the outdoor heat exchanger 30. The propeller fan 38 is rotatably driven by a fan motor 39.

#### <Constitution of the Indoor Unit>

Figure 3 shows a side cross section of the indoor unit 2.

The indoor unit 2 comprises components such as the abovementioned cross flow fan 21 and the indoor heat exchanger 20, and an indoor unit casing 23a that houses them.

The cross flow fan 21 is rotatably driven around the central axis by the indoor fan motor 22, consequently generating air flow, in which air is taken in from intake ports 251, passed through the indoor heat exchanger 20, and discharged from the outlet 252 into the room. The cross flow fan 21 is disposed generally in the center of the indoor unit 2 in the side view.

The indoor heat exchanger 20 is attached such that it surrounds the front, top, and upper rear portions of the cross flow fan 21. In the indoor heat exchanger 20, heat is exchanged between the air, which is taken in from the intake ports 251 by driving of the cross flow fan 21, toward the cross flow fan 21, and a refrigerant that flows inside a heat transfer pipe. The indoor heat exchanger 20 has a generally reverse V cross section in the side view. (Constitution of the Indoor Unit Casing 23a)

The indoor unit casing 23a mainly comprises a bottom frame 24, a front grill 25a, and a front panel 26a.

The bottom frame 24 constitutes the back side of the indoor unit 2 and covers the

back of the indoor heat exchanger 20 and the cross flow fan 21.

The front grill 25a is formed such that it covers the top surface, side surfaces, and bottom surface of the indoor unit 2, and a front panel 26a is attached to the front portion of the front grill 25a (refer to Figures 3 and 4). The top surface of the front grill 25a is provided with the intake ports 251 which comprise a plurality of slit-shaped openings. The intake ports 251 are provided generally across the top surface of the front grill 25a. The front side of the bottom surface of the front grill 25a is provided with the outlet 252 which comprises an opening along the longitudinal direction of the indoor unit 2. Additionally, the outlet 252 is provided with a horizontal flap 253 by which the air to be discharged into the room is guided. This horizontal flap 253 is provided such that it can freely rotate around a shaft, which is parallel to the longitudinal direction of the indoor unit 2. The horizontal flap 253 is capable of opening and closing the outlet 252 by rotating by a flap motor (not shown).

The front panel 26a is arranged at the front surface of the indoor unit 2. The front panel 26a is formed as a separate body from the front grill 25a and is attached such that it covers the front surface of the front grill 25a. The front side of the front panel 26a is constituted by two surfaces separated vertically by a step provided horizontally, and each surface is formed in generally a flat shape with a smooth texture without an opening such as a concave or convex portion, a hole, or a slit. In addition, the step portion defines an opening, and the air inside the room is also taken in by this opening (refer to the solid white arrow A1 on Figure 3). This front panel 26a is formed from a transparent resin, and a coated portion 261 which covers the entire reverse side of the front panel 26a is provided with a painting layer 27a that is given a color scheme, pattern, and the like. This painting layer 27a is formed by applying painting on the entire reverse side of the front panel 26a. Note that this front panel 26a is, as shown in Figure 4, attached to the front grill 25a via a hinge 71. In addition, this front panel 26a can open and close by this hinge 71.

As shown in Figure 4, the front surface of the front grill 25a is provided with openings 254. Various filters 50, 51, 52 are provided between the front surface of the front grill 25a and the front panel 26a, so that the openings 254 are covered by the filters 50, 51, 52. These filters 50, 51, 52 comprise the air filter 50, the air cleaning filter 51, and the photocatalytic filter 52.

The air filter 50 is capable of removing dust and dirt from the air that passes therethrough. The air filter 50 is provided such that it covers from the front surface to the top surface of the front grill 25a. A portion of the air filter 50, which lies against the top surface of the front grill 25a, is located immediately below the intake ports 251 provided at the top surface.

The air cleaning filter 51 is provided at a position which is the upper front portion of

the front grill 25a and the inner side the air filter 50. The air cleaning filter 51 is capable of removing dust, cigarette smoke, pollen, and the like, which are finer than the air filter 50.

The photocatalytic filter 52 is provided at the lower front portion of the front grill 25a, and is capable of removing a malodor component and hazardous gas from the air that passes therethrough. A malodor component is a component such as formaldehyde, acetaldehyde, ammonia, and hydrogen sulfide, which is a cause of malodor generated from cigarettes, raw garbage, building materials, and the like. A hazardous gas is a harmful component such as nitrogen oxide and sulfur oxide, which is contained in vehicle exhaust emissions and the like. The photocatalytic filter 52 is formed in a sheet shape having a honeycomb structure, and contains a photocatalyst that is mainly composed of titanium dioxide. The photocatalyst has a powerful oxidizing power by being activated by light, and is capable of decomposing malodor components and hazardous gases and making them innocuous.

#### <Method for Manufacturing of the Indoor Unit>

Next, the method for manufacturing the indoor unit 2 according to the first embodiment is explained.

The method for manufacturing the indoor unit 2 of this air conditioner 1 is, as shown in Figure 5, mainly formed by step S1 for manufacturing the indoor unit casing 23a, step S2 for manufacturing other components, and step S3 for assembling them.

Step S1 for manufacturing the indoor unit casing 23a is, as shown in Figure 6, constituted by step S10 for manufacturing the front grill 25a, step S11 for manufacturing the bottom frame 24, and a step S12 for manufacturing the front panel 26a.

In step S10 for manufacturing the front grill 25a and step S11 for manufacturing the bottom frame 24, the front grill 25a and the bottom frame 24 are respectively integrally molded from a resin material, or respectively manufactured by assembling components that are molded from a resin material.

Step S12 for manufacturing the front panel 26a is constituted by step S13 for molding the front panel 26a, step S14 for applying painting, and step S15 for mounting the hinge 71. In step S13 for molding the front panel 26a, the front panel 26a is molded from a transparent resin material and thus the transparent front panel 26a is manufactured. A resin material such as a transparent ABS, polystyrene, and the like is used as a transparent resin material in this invention. In step S14 for applying painting, painting is applied on the entire reverse side of the front panel 26a. In this step S14 for applying painting, the painting layer 27a which is given a color scheme and/or pattern is provided in close contact with a coated portion 261 on the reverse side of the front panel 26a. Note that, instead of painting, printing may be applied on the reverse side of the front panel 26a. In step S15 for mounting the hinge



71, as shown in Figure 7, the hinge 71 is bonded to a specific position on the reverse side of the front panel 26a. Note that the hinge 71 is attached on the painting layer 27a.

In step S2 for manufacturing other components, the abovementioned indoor heat exchanger 20, cross flow fan 21, each of the filter 50, 51, 52, and the like are manufactured.

5 In step S3 for assembling, the abovementioned components are assembled together, completing the indoor unit 2.

#### <Characteristics>

With the indoor unit 2 of the air conditioner 1 according to the first embodiment, the painting layer 27a is provided on the reverse side surface of the front panel 26a. Then the  
10 hinge 71 is attached on the painting layer 27a. Therefore, the hinge 71 cannot be seen from the front of the indoor unit 2. Thus, it is possible to obviate a risk that the design of the front panel 26a of the indoor unit 2 may be hampered by the hinge 71.

#### <Modified Example>

The front panel 26a according to the first embodiment has the hinge 71 which is  
15 attached thereto in step S15 for mounting the hinge 71. However, instead of the hinge 71, in the same step S15, a mounting member 72 integrally including a hinge 72a and a lower clip 72b, or a lower clip 73 shown in Figure 8 may be attached to the front panel 26. In so doing, it is possible to obviate a risk that the design of the front panel 26a of the indoor unit 2 may be hampered by the hinge 72a and the lower clips 72b, 73.

#### 20 <Second Embodiment>

##### <Entire Structure of the Air Conditioner>

The entire structure of the air conditioner according to the second embodiment is the same as the entire structure of the air conditioner according to the first embodiment, excepting the front panel.

##### 25 <Schematic Constitution of the Refrigerant Circuit of the Air Conditioner>

The schematic constitution of the refrigerant circuit of the air conditioner according to the second embodiment is the same as the schematic constitution of the refrigerant circuit of the air conditioner according to the first embodiment.

##### <Constitution of the Indoor Unit>

30 The constitution of the indoor unit according to the second embodiment is the same as the constitution of the indoor unit according to the first embodiment, excepting the constitution of the indoor unit casing.

##### (Constitution of the Indoor Unit Casing)

The constitution of the indoor unit casing according to the second embodiment is  
35 entirely the same as the constitution of the indoor unit casing according to the first embodiment, excepting that the front panel is not transparent and that the front panel

comprises a decoration panel.

Figure 9 shows a front panel 26b and a decoration panel 83 according to the second embodiment.

The front panel 26b is formed from a resin containing powder for coloring and the like. This front panel 26b is attached to the front grill 25a via a hinge 74. Note that this front panel 26b can open and close by this hinge 74. In addition, this front panel 26b is provided with fitting members 91a, 92a for receiving mounting clip 91b, 92b of the decoration panel 83 (refer to Figures 11 and 12) which are described later.

The decoration panel 83 is formed as a separate body from the front panel 26b, and as shown in Figure 9, is attached such that the decoration panel 83 covers the surface lower than the horizontal step on the front panel 26b. This decoration panel 83 is formed from a transparent resin, and as shown in Figure 16, a coated portion 262 which covers the entirety of the reverse side thereof is provided with a painting layer 27b which is given a color scheme, pattern, and the like. This painting layer 27b is formed by applying painting on the entire reverse side of the decoration panel 83. Note that this decoration panel 83 is integrally molded with the mounting clips 91b, 92b at a peripheral portion thereof, which enable the decoration panel 80 to be attached to the front panel 26b.

<Method for Manufacturing the Indoor Unit>

Next, the method for manufacturing the indoor unit 2 according to the second embodiment is described. Note that the method for manufacturing the indoor unit 2 according to the second embodiment is entirely the same as the method manufacturing the indoor unit according to the first embodiment, excepting manufacturing of the indoor unit casing. Therefore, only manufacturing of the indoor unit casing is described in this embodiment.

Step S1 for manufacturing the indoor unit casing 23a is, as shown in Figure 10, constituted by step S10 for manufacturing the front grill 25a, step S11 for manufacturing the bottom frame 24, step S20 for manufacturing the front panel 26b, and step S21 for manufacturing the decoration panel 83.

In step S10 for manufacturing the front grill 25a, step S11 for manufacturing the bottom frame 24, and step S20 for manufacturing the front panel 26b, the front grill 25a, the bottom frame 24, and the front panel 26b are respectively integrally molded from a resin material, or respectively manufactured by assembling components that are molded from a resin material. Note that in step S20 for manufacturing the front panel 26b, the hinge 74 (for attaching to the front grill 25a) is integrally molded therewith.

Step S21 for manufacturing the decoration panel 83 is constituted by step S22 for molding the decoration panel 83 and step S23 for applying painting. In step S20 for molding the decoration panel 83, the decoration panel 83 is molded from a transparent resin material,

and thus the transparent decoration panel 83 is manufactured. Note that a resin material such as a transparent ABS, polystyrene, and the like is used as a transparent resin material in this invention. In addition, here, the mounting clips 91b, 92b (for attaching to the front panel 26b) are integrally molded with the decoration panel 83. In step S23 for applying painting, painting is applied on the entire reverse side of the decoration panel 83. By this step S23 for applying painting, the painting layer 27b which is given a color scheme, pattern, and the like is provided in close contact with the coated portion 262 of the reverse side of the decoration panel 83. Note that, instead of painting, printing may be applied on the reverse side of the decoration panel 83.

#### <Characteristics>

With the indoor unit 2 of the air conditioner 1 according to the second embodiment, the decoration panel 83 is attached to the front panel 26b. In addition, the front panel 26b is colored. Therefore, the hinge 74 cannot be seen from the front of the indoor unit 2. Thus, it is possible to obviate a risk that the design of the front panel 26a of the indoor unit 2 may be hampered by the hinge 74.

#### <Modified Example>

The decoration panel 83 according to the second embodiment is integrally provided with the mounting clips 91b and 92b at a peripheral portion thereof to be attached to the front panel 26b. However, the attachment mode of the decoration panel 83 to the front panel 26b is not limited to the above manner. For example, as shown in Figure 13, the decoration panel 84 may be attached to the front panel 26b by fusion. In this case, the decoration panel 84 is provided with a projection at a peripheral portion thereof, and a front panel 26c (unlike the front panel 26b, the front side of the front panel 26c is flat without a step, however, attaching the decoration panel 84 to the front panel 26c will create a step) is provided with a hole suitable to the shape of the projection at a position corresponding to position of the projection. In addition, the front panel 26c needs to be provided with an inlet port for the filters 50, 51, 52. Then, after the projection is inserted to the hole, an appropriate amount of heat is applied to the projection from the back to fuse and integrate the projection with the front panel 26b. In addition, as shown in Figure 14, the decoration panel 80 may be attached to the front panel 26b by screws. In this case, it is preferable that the screws be threaded at a peripheral portion of the decoration panel 80 so that the design of the decoration panel 80 will not be hampered. Further, as shown in Figure 15, it is conceivable that the decoration panel 81 is attached to the front panel 26b by bonding. Also in this case, attention should be paid not to hamper the design of the decoration panel 81.

Note that all the decoration panels 80, 81, and 84 used for the methods described above are molded from a transparent resin, and the painting layer 27b is provided on the

coated portion 262 of the reverse side of the decoration panels 80, 81, and 84.

#### **INDUSTRIAL APPLICABILITY**

5       The indoor unit of the air conditioner according to the present invention obviates a risk that the design of the front panel of the indoor unit may be hampered by a hinge. In addition, the method for manufacturing the indoor unit of the air conditioner according to the present invention enables manufacturing of an indoor unit with a highly attractive design. As a result, it is possible to provide to the market an indoor unit that is a more attractively designed than conventional indoor units.